

# **Challenges of Urban Drainage Systems in Southern African Cities: The Case of Kabwe, Zambia <sup>1</sup>**

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## **Abstract**

Urban drainage systems in Southern African cities face significant challenges due to rapid urbanization, inadequate infrastructure, and poor maintenance. Kabwe, Zambia, exemplifies these struggles, with frequent flooding, waterlogging, and environmental degradation exacerbating public health risks and disrupting livelihoods. This study explores the key factors contributing to drainage inefficiencies in Kabwe, including unplanned settlements, blocked waterways, and limited investment in drainage infrastructure. Using a combination of spatial analysis, the research assesses the impact of ineffective drainage systems on urban sustainability and community well-being. The findings highlight the urgent need for integrated urban planning, improved drainage maintenance, and policy interventions to enhance resilience against climate-induced flooding. Addressing these issues is crucial for promoting sustainable urban development in Kabwe and other cities facing similar drainage challenges across Southern Africa.

**Keywords:** Urban Drainage | Flooding | Infrastructure | Stormwater Management | Climate Change | Erosion | Wastewater | Urbanization | Sustainability | Resilience.

## **Introduction**

Urban drainage systems play a crucial role in managing stormwater, preventing flooding, and ensuring environmental sustainability in rapidly growing cities (UN-Habitat, 2020). However, many cities in Southern Africa, including Kabwe in Zambia, face significant challenges in maintaining effective drainage infrastructure. Rapid urbanization, poor planning, inadequate investment in drainage systems, and the impacts of climate change contribute to frequent flooding, erosion, and waterborne diseases (World Bank, 2021). In Kabwe, these challenges are exacerbated by informal settlements, blocked drainage channels, and a lack of proper waste management (Chanda & Mwiinga, 2019). This study examines the key issues affecting urban drainage in Kabwe, highlighting their causes,

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impacts, and potential solutions to improve the city's resilience against water-related hazards.

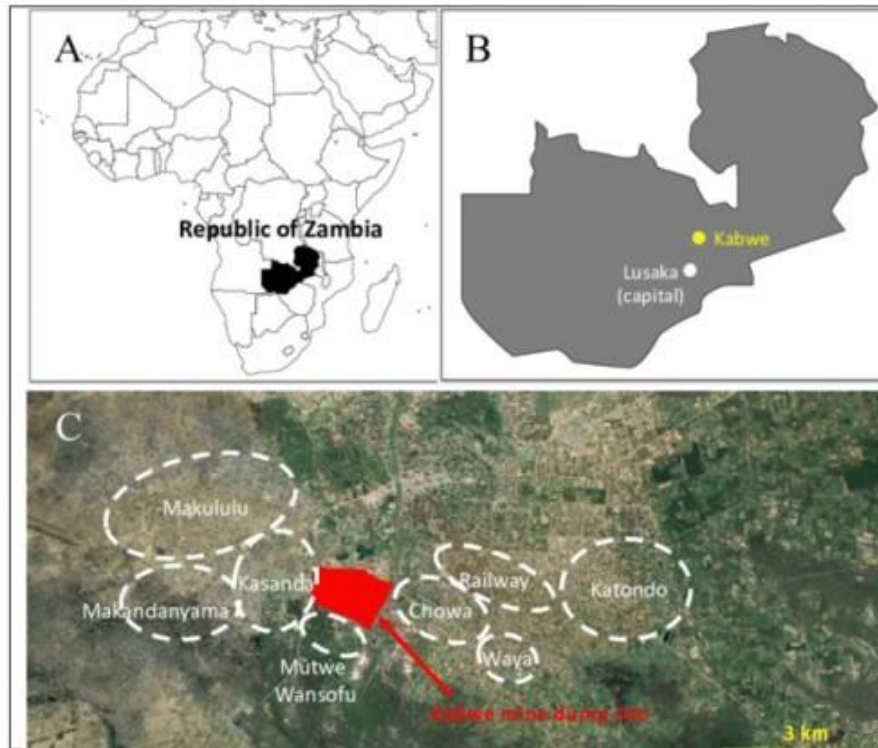


Figure 1: Map showing (A) the location of the Republic of Zambia, (B) Kabwe district, and (C) townships in Kabwe district. Adapted from Environmental Monitoring and Contaminants Research · September 2022



Figure 2: Shows the drainage map for Kabwe and neighboring Districts. (Source: Kabwe District State of Environment Outlook Report 2010).

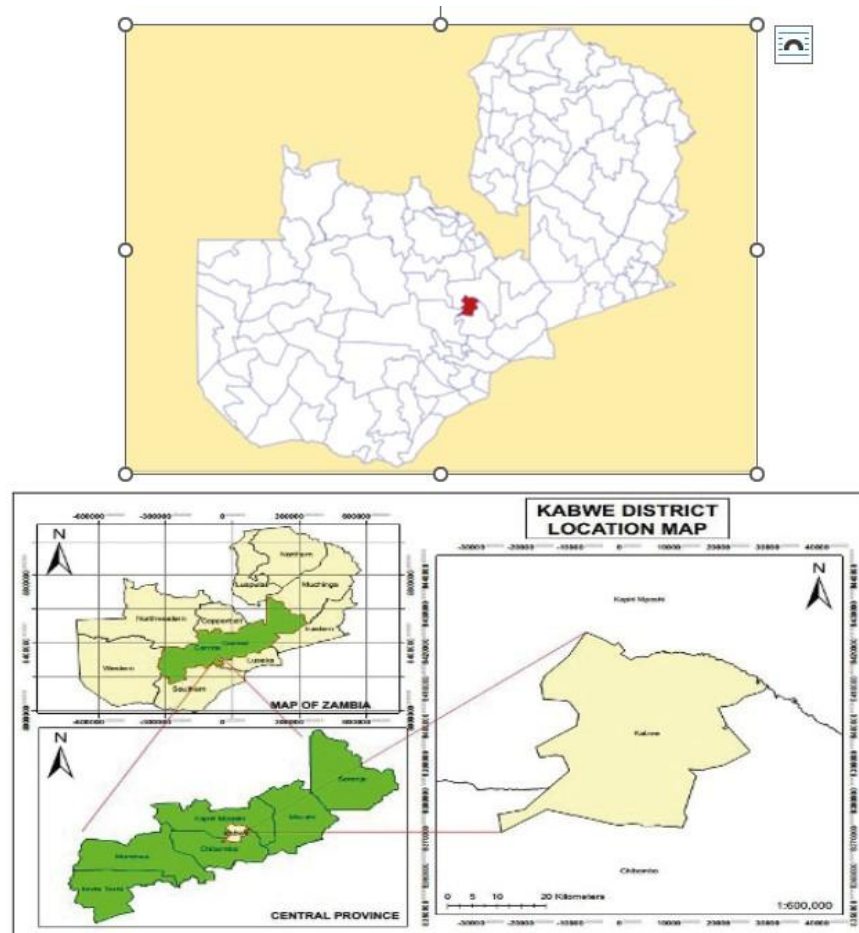


Figure 3: Shows the Location of Kabwe District – Source: KIDP 2023-2033

## Background and Context

Urban drainage systems are essential for managing stormwater, reducing the risk of flooding, and ensuring environmental sustainability in growing cities. However, many cities in Southern Africa, including Kabwe in Zambia, struggle with inadequate drainage infrastructure due to rapid urbanization, poor urban planning, and limited financial resources (UN-Habitat, 2020). The expansion of informal settlements without proper drainage planning has further exacerbated flooding and erosion, leading to severe social and economic impacts (World Bank, 2021).

In Kabwe, the problem is intensified by clogged and poorly maintained drainage channels, which are often obstructed by waste and debris due to ineffective waste management

practices (Chanda & Mwiinga, 2019). Climate change has also contributed to more extreme weather events, such as heavy rainfall, which overwhelms the existing drainage infrastructure and increases the risk of waterborne diseases and property damage (IPCC, 2021). Addressing these challenges requires a multi-faceted approach, including policy reforms, improved drainage infrastructure, and community engagement to ensure sustainable urban water management.



**Figure 4: Shows the blocked drainage in intra bus station – Kabwe (Source: engineering Department - Kabwe Municipal Council)**

## Significance of the Study

This study is significant as it provides critical insights into the challenges associated with urban drainage systems in Southern African cities, with a specific focus on Kabwe, Zambia. The findings will be valuable in several ways:

1. **Policy Formulation and Urban Planning** – The study will contribute to evidence-based policy recommendations for improving drainage infrastructure and flood mitigation strategies in Kabwe and other cities facing similar challenges.

2. **Infrastructure Development** – By identifying gaps in the existing drainage systems, the research will inform the design and implementation of more efficient and sustainable stormwater management solutions.
3. **Environmental Protection** – Understanding drainage issues will help mitigate the negative environmental impacts, such as soil erosion, water pollution, and degradation of urban ecosystems.
4. **Climate Change Adaptation** – The study will highlight the role of urban drainage systems in enhancing climate resilience, particularly in managing extreme weather events such as heavy rainfall and flash floods.
5. **Public Health and Sanitation** – Poor drainage contributes to the spread of waterborne diseases. This research will emphasize the importance of proper stormwater management in improving public health outcomes.
6. **Community Livelihoods and Economic Impact** – Flooding and poor drainage can lead to property damage, displacement, and economic losses. The study will assess how inadequate drainage systems affect the socioeconomic well-being of urban residents.
7. **Sustainable Urbanization** – With rapid urban growth, the study will provide recommendations on integrating drainage solutions into urban development plans to ensure long-term sustainability.
8. **Capacity Building and Stakeholder Engagement** – The research will support local authorities, engineers, environmentalists, and policymakers in making informed decisions and fostering collaboration in drainage management.

### Objectives

1. To assess the effectiveness of the existing urban drainage infrastructure in Kabwe, Zambia, and its capacity to manage stormwater and prevent flooding.
2. To identify the key challenges contributing to poor drainage systems in Kabwe, including environmental, socioeconomic, and governance-related factors.

### Theoretical Framework

The study on urban drainage challenges in Kabwe, Zambia, can be framed using multiple theoretical perspectives that highlight the interplay between environmental, governance, and socio-economic factors. The following theories provide a robust foundation for analyzing the issue:

## 1. Urban Political Ecology (UPE) Theory

Urban Political Ecology examines how power dynamics, governance structures, and socio-economic inequalities shape urban infrastructure and environmental challenges.

### Relevance to the Study:

Highlights how governance inefficiencies contribute to poor drainage infrastructure.

Explores the impact of political and economic interests on urban development and service delivery.

Analyzes how marginalized communities are disproportionately affected by inadequate drainage systems.

## 2. Systems Theory

Urban drainage systems are part of a broader urban ecosystem, and their effectiveness depends on the interaction between natural and human-made components.

### Relevance to the Study:

Helps in understanding drainage as an interconnected system influenced by land use, topography, and climate.

Emphasizes the need for integrated stormwater management approaches.

Identifies weaknesses in infrastructure planning and their cascading effects.

## 3. Sustainable Urban Drainage Systems (SuDS) Framework

This framework promotes nature-based solutions and resilient infrastructure to manage urban water challenges sustainably.

### Relevance to the Study:

Provides guidelines for eco-friendly and cost-effective drainage solutions.

Highlights the role of green infrastructure, such as permeable surfaces and retention ponds.

Supports climate adaptation strategies for flood-prone urban areas.

## 4. Institutional Theory

Institutional arrangements, policies, and governance structures determine how urban infrastructure is planned and managed.

### **Relevance to the Study:**

Assesses the effectiveness of local government policies on drainage management.

Examines institutional bottlenecks that hinder drainage system improvements.

Evaluates the role of stakeholders, including municipalities, residents, and private actors, in addressing drainage challenges.

### **5. Climate Change Adaptation Theory**

Urban infrastructure must adapt to increasing climate variability and extreme weather events, such as heavy rainfall and flooding.

### **Relevance to the Study:**

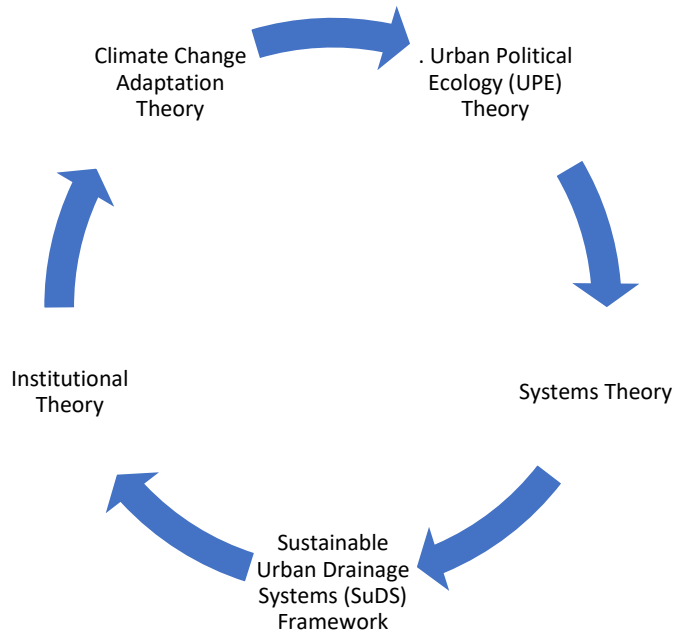
Explains the impact of climate change on drainage system failures.

Encourages the integration of climate resilience strategies in urban planning.

Promotes policy recommendations for sustainable stormwater management.

This theoretical framework integrates environmental, institutional, and socio-political perspectives to analyze the challenges of urban drainage systems in Kabwe. It provides a foundation for identifying gaps in governance, infrastructure, and policy implementation, ultimately guiding recommendations for sustainable drainage solutions in Southern African cities.

## Conceptual Framework



**Figure 5: Shows Conceptual framework- Source Author 2025.**

### Methodology

The methodology is grounded in a thorough review of existing literature on urban governance, which emphasizes the interconnections between data systems, technical tools, and institutional capacity in achieving effective urban planning outcomes. This study primarily adopts a literature review approach, focusing on scholarly publications relevant to the topic to provide a detailed and comprehensive analysis of the challenges faced by Kabwe Municipal Council. By synthesizing findings from prior studies, the research aims to uncover recurring themes and insights that inform the Challenges of Urban Drainage Systems in Southern African Cities: The Case of Kabwe, Zambia.

### Review of Armitage et al. (2013) in Relation to Challenges of Urban Drainage Systems in Southern African Cities: The Case of Kabwe, Zambia

The publication by Armitage et al. (2013), *Alternative Technology for Stormwater Management: The South African Guidelines for Sustainable Drainage Systems*, offers valuable insights into stormwater management challenges and solutions, which are highly



relevant to Kabwe's urban drainage issues. Their work emphasizes sustainable urban drainage systems (SuDS) as an alternative to conventional drainage systems, which often fail in rapidly urbanizing African cities. Below is an extended discussion linking their findings to the challenges in Kabwe, Zambia.

### **1. Inadequacies of Conventional Drainage Systems in Southern Africa**

Armitage et al. (2013) highlight that traditional drainage approaches—such as concrete stormwater channels and underground pipes—are often inadequate due to rapid urbanization, limited maintenance, and climate variability. In Kabwe, Zambia, similar challenges are evident:

The existing drainage infrastructure is outdated and lacks the capacity to handle increasing stormwater loads.

Heavy rainfall events often lead to localized flooding, especially in informal settlements.

Poor maintenance and blocked drains caused by waste disposal and sedimentation exacerbate the problem.

### **2. Climate Change and Extreme Weather Events**

The study emphasizes that climate change is intensifying storm events, leading to more frequent and severe flooding. Southern African cities, including Kabwe, experience:

Irregular and intense rainfall patterns that overwhelm existing drainage systems.

Increased soil erosion contributing to sediment build-up in drainage channels.

The need for climate-resilient infrastructure that integrates nature-based solutions.

### **3. The Role of Sustainable Urban Drainage Systems (SuDS) as a Solution**

Armitage et al. (2013) propose SuDS as a viable alternative, which aligns with the needs of Kabwe's drainage system. Key aspects include:

Permeable surfaces (e.g., green pavements) to reduce runoff.

Retention ponds and wetlands to manage excess stormwater.

Community-based maintenance programs to ensure sustainability.

Integration of drainage planning with urban land-use policies to prevent construction on flood-prone areas.

#### **4. Institutional and Governance Challenges in Drainage Management**

The study stresses that institutional capacity is critical for effective drainage management. Kabwe Municipal Council faces similar governance challenges:

Lack of financial resources to invest in modern stormwater infrastructure.

Poor coordination between local authorities, planners, and environmental agencies.

Weak enforcement of urban planning regulations, leading to construction in flood-prone areas.



**Figure 6: Shows the unblocking of drainage system in the CBD- Kabwe. (pictures from engineering Department Kabwe Municipal Council)**

#### **5. Recommendations for Kabwe**

**Sustainable Drainage System Implementation:** Shift towards nature-based solutions like wetlands, bioswales, and rain gardens.

**Stronger Urban Drainage Policies:** Develop and enforce policies that restrict construction in flood-prone areas.

**Community Involvement in Drainage Maintenance:** Public awareness and local participation can improve stormwater management and waste disposal practices.

**Capacity Building and Funding:** Strengthen institutional capacity and seek external funding for drainage improvement projects.



**Figure 7: Shows unblocked drainages which were silted due to Capacity. Kabwe (CBD). (pictures from engineering Department Kabwe Municipal Council)**

### **REVIEW of Carden, Fisher-Jeffes, & Armitage (2013): Challenges Facing Implementation of Water Sensitive Urban Design in South Africa**

Carden, Fisher-Jeffes, and Armitage (2013) provide critical insights into Water Sensitive Urban Design (WSUD) and its application in urban drainage systems. Their study focuses on South Africa but has broader applicability to other Southern African cities, including Kabwe, Zambia, given similar challenges in urban governance, infrastructure, and environmental management.

#### **Inadequate Urban Drainage Infrastructure**

The study highlights poorly designed or aging drainage systems as a significant challenge, often resulting in frequent flooding and waterlogging.

Like many Southern African cities, Kabwe faces drainage system failures due to limited investment in infrastructure, outdated systems, and increasing urbanization pressures that exceed design capacities.

#### **Institutional and Policy Constraints**

Carden et al. (2013) discuss how the lack of coordination between municipalities, water management authorities, and urban planners impedes the adoption of sustainable urban drainage solutions.

The Kabwe Municipal Council likely faces similar institutional challenges, including fragmented governance, unclear mandates, and bureaucratic inefficiencies that hinder integrated water-sensitive urban planning.



**Figure 8: Shows Silt and debris removal from underground drainages. Kabwe (CBD)  
(pictures from engineering Department Kabwe Municipal Council)**

### **Climate Change and Rainfall Variability**

The study underscores how increased storm intensity and erratic rainfall patterns challenge traditional drainage infrastructure. (see appendix 1)

Kabwe, like many Zambian cities, is experiencing climate-induced flooding, exacerbated by poor drainage maintenance and impervious urban surfaces that prevent proper stormwater absorption.

### **Limited Public Awareness and Community Engagement**

The study finds that low levels of public awareness about sustainable water management contribute to inefficient drainage practices and urban flooding.

Informal settlements and poor waste disposal practices, such as dumping solid waste in drainage channels, further worsen the city's drainage problems, necessitating community education and engagement. (see appendix 2)

### **Financial and Technical Constraints**

The researchers emphasize budget limitations and inadequate technical expertise as key barriers to implementing WSUD strategies.

Financial constraints at the local government level limit investment in modern drainage solutions, while a shortage of skilled urban planners and hydrologists impedes effective implementation of drainage infrastructure projects.

Proposed Solutions Based on the Study and Their Relevance to Kabwe

### **Adopting Nature-Based Solutions (NBS)**

Green infrastructure such as constructed wetlands, permeable pavements, and vegetated swales can improve stormwater management.

In Kabwe, incorporating such WSUD principles can help reduce surface runoff and enhance groundwater recharge.

### **Strengthening Institutional Coordination**

Multi-sector collaboration between local authorities, environmental agencies, and civil society groups can enhance drainage governance.

Kabwe needs inter Institutional coordination between water, sanitation, and urban planning sectors to effectively manage urban drainage challenges.

### **Enhancing Public Participation and Awareness**

Community-led initiatives, such as waste management programs and participatory urban drainage maintenance, can improve system functionality.

Local sensitization programs in Kabwe can reduce illegal dumping into drainage channels, minimizing blockage-induced flooding. (see appendix 3)

### **Investing in Climate-Resilient Infrastructure**

Cities must integrate climate adaptation measures in urban planning, such as increasing drainage capacity and designing flood-resilient neighborhoods.

Kabwe could benefit from climate-proofing drainage networks and using flood modeling to inform future urban expansions.

### **Leveraging External Funding and Capacity Building**

Public-private partnerships (PPPs), donor support, and capacity-building programs can provide funding and technical expertise for sustainable drainage projects.

Kabwe's local authorities should seek support from international urban resilience programs, research institutions, and development organizations.

**In their 2021 study review, Chanza and de Wit examine the intricate relationship between urbanization and flood risks in Sub-Saharan Africa (SSA).**

Focusing on the Antananarivo agglomeration in Madagascar. Their research reveals that rapid urban expansion, driven by exponential population growth, has significantly increased the exposure of both populations and infrastructure to flood hazards. Notably, by 2018, approximately 32% of Antananarivo's population resided in flood-prone areas, with built-up zones in these regions expanding from 399 hectares in 1953 to 3,675 hectares in 2017. This expansion indicates that nearly one in four buildings were situated in flood-prone zones by 2017. A considerable portion of this growth is attributed to informal developments housing economically vulnerable groups, underscoring the pressing need for integrating flood risk management into spatial planning policies to harmonize urban development with effective drainage infrastructure.

Drawing parallels to Kabwe, Zambia, similar challenges emerge. Kabwe has experienced rapid urbanization, leading to the proliferation of informal settlements, often in areas susceptible to flooding. The city's drainage infrastructure has struggled to keep pace with this growth, resulting in increased flood risks during heavy rainfall events. The situation is exacerbated by inadequate urban planning and limited resources, which hinder the development and maintenance of effective drainage systems.

The insights from Chanza and de Wit's study highlight the critical importance of proactive urban planning that incorporates flood risk assessments. For Kabwe, this could involve:

**Implementing Integrated Flood Risk Management:** Developing comprehensive strategies that combine structural measures, such as the construction of efficient drainage networks, with non-structural approaches, including community education and land-use planning.

**Enhancing Institutional Capacity:** Strengthening the capabilities of local authorities to enforce building codes, regulate land use, and coordinate disaster response efforts effectively.

**Promoting Sustainable Urban Development:** Encouraging the use of green infrastructure, such as permeable surfaces and urban green spaces, to enhance natural water absorption and reduce surface runoff.

**Engaging Local Communities:** Involving residents in decision-making processes to ensure that interventions are contextually appropriate and socially inclusive.

## **Review of Clark, J. (2020) *Uneven Innovation: The Work of Smart Cities***

Clark's (2020) *Uneven Innovation: The Work of Smart Cities* provides a critical examination of how urban governance and technological advancements shape city infrastructure, with a particular emphasis on disparities in implementation. While Clark's primary focus is on smart cities, the theoretical framework he presents is highly relevant to understanding the challenges of urban drainage systems in Southern African cities, specifically Kabwe, Zambia.

### **The Concept of Uneven Innovation in Urban Infrastructure**

Clark argues that technological advancements in urban infrastructure often benefit wealthier urban areas while marginalizing informal settlements and lower-income communities. This insight is crucial in the case of Kabwe, where drainage system improvements have primarily focused on central business districts, leaving informal and peri-urban settlements vulnerable to flooding and water stagnation. (See Appendix 5)

The lack of equitable investment in drainage infrastructure disproportionately affects informal settlements, leading to recurrent flooding.

Technological tools such as GIS-based drainage mapping and real-time flood monitoring are underutilized in Kabwe due to inadequate institutional and technical capacity.

### **2. Data-Driven Urban Governance and Its Limitations**

Clark highlights the growing role of data-driven decision-making in urban governance and the integration of smart technologies in managing infrastructure. However, he cautions that cities with weak institutional frameworks and limited technical expertise often struggle to implement these innovations effectively.

The municipal council lacks an integrated data system for stormwater management, making it difficult to predict and mitigate drainage failures.

Limited coordination between different urban planning departments results in fragmented responses to drainage challenges.

### **3. Socioeconomic and Political Barriers to Drainage System Improvement**

Clark discusses how political and economic barriers shape urban development, emphasizing that financial constraints, bureaucratic inefficiencies, and policy fragmentation hinder the adoption of sustainable urban infrastructure solutions.

Budgetary constraints within the local government limit large-scale infrastructure improvements in drainage systems.

Political influences on land use and urban planning contribute to ineffective enforcement of drainage policies.

#### **4. Smart Urban Drainage as a Potential Solution**

Clark explores the potential of smart drainage systems, which integrate IoT sensors, automated flood detection, and predictive analytics to enhance urban resilience. However, he emphasizes that their success depends on local capacity, governance structures, and equitable access to technology.

While smart drainage solutions could improve water flow management in Kabwe, the city lacks the necessary technical infrastructure and expertise to implement them.

Community-driven solutions, such as participatory drainage mapping and local flood monitoring initiatives, could serve as an alternative in the absence of advanced technology.

#### ***Review of The G20's 2021 Framework on Capacity Building of Urban Administrations for Sustainable Development***

offers a comprehensive approach to enhancing urban governance, particularly in the context of urban drainage challenges faced by cities like Kabwe, Zambia. The framework emphasizes the necessity of robust institutional capacity, effective data systems, and technical tools to achieve sustainable urban planning outcomes.

#### **Institutional Capacity Building:**

**Vertical Coordination:** The framework highlights the importance of collaboration between local and higher levels of government. Such coordination ensures policy coherence, streamlines development planning, and optimizes resource allocation. For Kabwe, this means that the municipal council should work closely with national authorities to align urban drainage initiatives with broader development plans.

**Legal and Regulatory Support:** Establishing clear legal frameworks and guidelines for urban planning is crucial. These frameworks provide the foundation for implementing effective drainage systems and other infrastructural projects.



### **Data Systems and Technical Tools:**

**Infrastructure Design Codes:** The adoption of standardized design codes ensures that urban drainage systems are resilient and capable of handling environmental challenges. For Kabwe, implementing such codes can lead to more effective and sustainable drainage solutions.

**Service Delivery Standards:** Setting and adhering to service delivery benchmarks ensures that urban services, including drainage, meet the required quality and efficiency standards.

### **Community and Stakeholder Engagement:**

**Horizontal Coordination:** Collaboration with neighboring local authorities and stakeholders is vital. For Kabwe, engaging with adjacent municipalities can lead to integrated drainage solutions that address regional water management challenges.

**Public-Private Partnerships (PPPs):** The framework encourages cities to explore PPPs to leverage private sector expertise and resources. In Kabwe, such partnerships could facilitate the development and maintenance of urban drainage infrastructure.

**Citizen Participation:** Involving the community in urban planning and project implementation fosters a sense of ownership and ensures that solutions are tailored to local needs.

Kabwe faces significant challenges with its urban drainage systems, exacerbated by rapid urbanization, inadequate infrastructure, and environmental factors. Applying the G20 framework can provide a structured approach to address these issues:

**Enhancing Institutional Capacity:** Kabwe Municipal Council can benefit from capacity-building programs that focus on urban planning, project management, and intergovernmental coordination.

**Implementing Robust Data Systems:** Developing comprehensive data systems will enable better planning and management of drainage infrastructure, allowing for proactive maintenance and upgrades.

**Fostering Stakeholder Collaboration:** By engaging with the private sector, neighboring municipalities, and the local community, Kabwe can develop integrated and sustainable solutions to its drainage challenges.

## **Review of the Habitat III Policy Unit 4 (2016) Publication in Relation to the Challenges of Urban Drainage Systems in Southern African Cities: The Case of Kabwe, Zambia**

The Habitat III Policy Unit 4 (2016) report on Urban Governance, Capacity, and Institutional Development provides a foundational perspective on how governance structures, institutional capacity, and policy development influence urban service delivery, including drainage infrastructure. The publication is highly relevant in analyzing the challenges of urban drainage systems in Southern African cities, particularly Kabwe, Zambia, by emphasizing the following key themes:

### **Governance and Institutional Frameworks in Urban Drainage Management**

The Habitat III report underscores the need for strong urban governance systems to ensure efficient service delivery. In the context of Kabwe's drainage challenges, the lack of coordination between national, provincial, and local authorities exacerbates the problem. The local government's institutional capacity is limited in enforcing urban planning regulations, leading to poor drainage infrastructure development.

Weak coordination between Kabwe Municipal Council (KMC), the Ministry of Local Government, and other relevant agencies.

Limited enforcement of land use planning laws, resulting in encroachment on drainage corridors.

Inadequate stakeholder participation, particularly from local communities and private sector actors.

Strengthening institutional collaboration between local and central governments.

Enhancing governance mechanisms for participatory urban planning.

Implementing robust policy frameworks that prioritize sustainable urban drainage.

### **Technical and Capacity Constraints in Drainage Infrastructure Development**

The Habitat III report highlights the lack of technical expertise in urban management as a critical barrier to effective infrastructure planning. In Kabwe, urban planners, engineers, and environmental experts face challenges in implementing modern drainage solutions. The situation is worsened by outdated drainage systems that fail to cope with increasing urbanization and climate variability.

## Technical Challenges in Kabwe

Aging drainage networks that do not meet the city's current needs.

Lack of skilled personnel in advanced stormwater management.

Inadequate funding for drainage system upgrades and maintenance.

Investment in capacity-building programs for local engineers and urban planners.

Adoption of modern stormwater management technologies, such as Sustainable Drainage Systems (SuDS).

Strengthening technical cooperation with international development organizations.

### 3. The Role of Data-Driven Urban Planning in Drainage System Efficiency

The Habitat III report emphasizes data collection and analysis as crucial for informed urban planning. However, in Kabwe, there is limited availability of spatial and hydrological data, making it difficult to design and implement effective drainage solutions.

Lack of digital mapping and Geographic Information Systems (GIS) for drainage planning.

Poorly maintained records of flood-prone areas.

Limited use of real-time data for stormwater management.

### Proposed Solution Based on Habitat III Principles:

Establishing a central urban data management system to integrate drainage information.

Implementing GIS-based monitoring systems for real-time flood prediction.

Enhancing data-sharing policies among government agencies and academic institutions.

### 4. Socioeconomic Factors and Public Engagement in Urban Drainage Management

The Habitat III report recognizes that urban governance is not only a technical issue but also a social and economic challenge. In Kabwe, informal settlements contribute to drainage problems due to poor waste disposal practices and lack of proper sanitation facilities, which clog drainage systems and increase flood risks.

### Socioeconomic Challenges in Kabwe

- Informal settlements expanding into flood-prone areas.
- Low community awareness on the impact of poor drainage maintenance.

- Limited public participation in drainage system planning.

#### **Proposed Solution Based on Habitat III Principles:**

- Strengthening community-based drainage management programs.
- Enhancing public awareness campaigns on waste management and flood prevention.
- Providing incentives for private sector involvement in drainage infrastructure development.

### **5. Climate Change and Disaster Resilience in Urban Drainage Systems**

The Habitat III report underscores climate change adaptation as a critical aspect of urban resilience. In Kabwe, increasing rainfall variability and extreme weather events overwhelm existing drainage infrastructure, leading to frequent urban flooding.

#### **Key Climate-Related Drainage Challenges in Kabwe**

- Unpredictable weather patterns resulting in heavy rainfall events.
- Increased soil erosion due to deforestation and poor land management.
- Limited integration of climate adaptation strategies in urban planning.

#### **Proposed Solution Based on Habitat III Principles:**

- Incorporating nature-based solutions, such as wetland restoration and green infrastructure.
- Strengthening early warning systems for flood prediction and response.
- Implementing climate-resilient infrastructure projects, including permeable pavements and retention basins.

### **Review of Jaglin's (2014) Work in Relation to Urban Drainage Challenges in Kabwe, Zambia**

Jaglin's (2014) publication, *Regulating Service Delivery in Southern Cities: Rethinking Urban Heterogeneity*, provides a critical perspective on urban service delivery, emphasizing the fragmented and often unequal distribution of essential services in Southern African cities. This framework can be applied to understanding the challenges of urban drainage systems in Kabwe, Zambia, as follows:

## **1. Urban Heterogeneity and Drainage Inequalities**

Jaglin (2014) highlights how Southern African cities exhibit a high degree of heterogeneity in service provision, where formal and informal systems coexist. In the context of Kabwe, urban drainage infrastructure is often inconsistent, with well-developed drainage in planned areas and inadequate or nonexistent systems in informal settlements. This disparity results in flooding, water stagnation, and sanitation issues, particularly in unplanned neighborhoods.

## **2. Fragmented Governance and Institutional Weaknesses**

A key argument in Jaglin's study is that governance structures in Southern cities are often fragmented, with multiple actors (local governments, private entities, and community-based organizations) involved in service delivery. In Kabwe, this manifests in the drainage sector through the lack of coordination between the municipal council, national government agencies, and informal community initiatives. Weak regulatory enforcement and limited financial resources further exacerbate the challenge of implementing sustainable drainage solutions.

## **3. Informal Arrangements and Adaptive Strategies**

Jaglin (2014) also explores how informal arrangements play a significant role in service provision, particularly where state-led interventions are weak. In Kabwe, residents in informal settlements often construct makeshift drainage systems or rely on community-led efforts to mitigate flooding. However, these solutions are typically short-term and ineffective in managing large-scale urban runoff, leading to recurring drainage failures.

## **4. Policy Implications and the Need for Hybrid Solutions**

Jaglin's work suggests that rather than imposing rigid, top-down service delivery models, urban governance should embrace hybrid approaches that integrate formal planning with informal practices. For Kabwe, this means developing drainage policies that:

- Strengthen collaboration between municipal authorities and informal community initiatives.
- Improve enforcement of land-use planning to prevent settlement in flood-prone areas.
- Encourage nature-based solutions, such as green infrastructure, to complement existing drainage networks.

## **Review of Khan & Swapan's (2013) Institutional Capacity-Building Framework in the Context of Urban Drainage Challenges in Kabwe, Zambia**

Khan and Swapan's (2013) study on institutional capacity-building in urban planning and policy-making for climate change adaptation provides a critical lens through which the challenges of urban drainage systems in Kabwe, Zambia, can be analyzed. Their research, based on Dhaka, Bangladesh, highlights the importance of strengthening institutional frameworks to improve resilience against climate-induced urban challenges. The key elements from their study can be adapted to the case of urban drainage systems in Southern African cities, particularly Kabwe.

### **1. Institutional Weakness and Drainage Governance in Kabwe**

Khan and Swapan (2013) emphasize that weak institutional capacity is a significant barrier to effective urban planning. In Kabwe, the lack of strong governance structures leads to:

- Poor enforcement of stormwater management policies
- Inadequate inter-agency coordination for drainage infrastructure development
- Limited funding and technical expertise for drainage system maintenance

### **2. Technical and Human Resource Capacity Gaps**

Khan and Swapan (2013) discuss how deficiencies in technical knowledge and human resource capacity hinder climate adaptation strategies. In Kabwe, these issues manifest as:

- Lack of skilled personnel for designing, implementing, and maintaining sustainable drainage solutions
- Limited use of GIS and remote sensing technologies for monitoring drainage efficiency
- Inadequate research and data collection on rainfall patterns and flood-prone zones

### **3. Policy Integration and Coordination for Sustainable Drainage**

One of the central themes of Khan and Swapan's (2013) study is the need for integrated policy frameworks that align climate adaptation with urban development. In Kabwe, the urban drainage sector faces fragmentation, where:

- Land-use planning does not integrate drainage management strategies
- Stormwater policies exist but are not effectively enforced

- Multiple stakeholders (municipality, environmental agencies, and communities) operate in silos

#### **4. Community Participation and Bottom-Up Approaches**

Khan and Swapan (2013) argue that community engagement is crucial for institutional capacity-building. In Kabwe, informal settlements and unplanned urbanization exacerbate drainage challenges. Community-led solutions can include:

- Public awareness campaigns on solid waste disposal to prevent clogged drainage systems
- Local-level monitoring committees to report drainage failures and flood risks
- Community-driven adaptation strategies, such as rainwater harvesting and sustainable urban drainage systems (SUDS)

#### **5. Financial and Investment Challenges in Drainage Infrastructure**

The study by Khan and Swapan (2013) identifies financial constraints as a key institutional challenge. In Kabwe, limited municipal funding affects:

- Maintenance and rehabilitation of drainage infrastructure
- Implementation of flood mitigation projects
- Access to international climate adaptation funding

To address this, Kabwe must explore public-private partnerships (PPPs), donor funding, and innovative financing mechanisms to improve drainage infrastructure.

**Conclusion:** Applying Institutional Capacity-Building to Kabwe's Urban Drainage Challenges

Khan and Swapan's (2013) findings highlight that strengthening institutional frameworks, technical capacity, policy integration, community participation, and financial investment is key to addressing urban governance issues. These principles can be directly applied to Kabwe's drainage challenges by:

1. Enhancing institutional coordination and governance for better policy implementation
2. Investing in technical expertise and data-driven planning for sustainable urban drainage

3. Promoting community-based approaches for flood risk mitigation
4. Securing financial resources through innovative funding strategies

### **Review of Manda's (2007) Insights on Informal Settlements and Urban Poor Housing to the Urban Drainage Challenges in Kabwe, Zambia**

Manda (2007) explores the Mchenga-Urban Poor Housing Fund in Malawi, emphasizing how urban poverty, informal settlements, and inadequate infrastructure shape urban governance and development. His study offers valuable insights that can be applied to Kabwe's urban drainage challenges, particularly in the context of informal settlements, governance, and financial constraints affecting drainage infrastructure.

#### **1. Informal Settlements and Their Impact on Urban Drainage in Kabwe**

Manda (2007) highlights how rapid urbanization and the growth of informal settlements in Malawi strain urban services, including water supply, sanitation, and drainage. Similarly, Kabwe has experienced an increase in informal settlements, where:

- Poorly planned housing encroaches on natural drainage paths, causing obstructions
- Lack of formal drainage systems results in localized flooding during heavy rains
- Unregulated construction leads to soil erosion, sedimentation, and drainage blockages

This scenario suggests that urban planning policies in Kabwe must prioritize infrastructure development in informal settlements to mitigate drainage problems.

#### **2. Governance and Institutional Challenges in Urban Drainage**

Manda (2007) discusses how weak governance structures in Malawi fail to integrate informal settlements into urban planning processes. Kabwe faces similar governance challenges, where:

- The municipal council lacks capacity to enforce urban planning regulations
- Land tenure issues make it difficult to implement formal drainage systems in unplanned settlements
- Limited coordination among local authorities, environmental agencies, and residents leads to ineffective drainage management



To overcome these challenges, Kabwe needs inclusive governance mechanisms that integrate informal settlements into citywide drainage planning.

### **3. Financial Constraints and Alternative Funding Models for Drainage Systems**

Manda (2007) examines how the Mchenga-Urban Poor Housing Fund provided financing solutions for low-income housing. This concept can be adapted to drainage infrastructure financing in Kabwe, where:

- Municipal funding for drainage projects is insufficient
- Informal settlements lack access to basic services, including stormwater management
- Residents in low-income areas cannot afford drainage fees or levies

Kabwe can adopt community-driven financing models and explore public-private partnerships (PPPs) to mobilize resources for drainage infrastructure.

### **4. Community Participation in Drainage Management**

Manda (2007) emphasizes the role of community participation in solving urban development challenges. In Kabwe, engaging local communities can:

- Promote awareness about proper waste disposal to prevent blocked drainage systems
- Encourage community-led drainage maintenance initiatives
- Facilitate dialogue between residents and municipal authorities to improve drainage planning

By empowering communities to participate in urban drainage solutions, sustainable and low-cost interventions can be implemented effectively.

### **5. Climate Change and the Vulnerability of Low-Income Areas**

Manda (2007) indirectly highlights the climate vulnerabilities of urban poor settlements. In Kabwe, informal settlements are disproportionately affected by:

- Increased flooding due to poor drainage infrastructure
- Waterborne diseases caused by stagnant water and inadequate sanitation
- Soil degradation and erosion, which further impact drainage efficiency

To address these risks, Kabwe must incorporate climate-resilient drainage solutions and prioritize flood-prone areas in urban planning strategies.

### **Conclusion: Lessons from Manda (2007) for Addressing Kabwe's Drainage Challenges**

Manda's (2007) work demonstrates how urban poverty, governance weaknesses, and financial constraints shape infrastructure development. Applying his insights to Kabwe, the following strategies should be considered:

1. Integrating informal settlements into urban drainage planning through inclusive policies
2. Strengthening municipal governance to enforce drainage regulations effectively
3. Developing innovative financing models for community-led drainage projects
4. Encouraging local participation in drainage management and maintenance
5. Implementing climate-resilient infrastructure to protect vulnerable communities

### **Review of Muller's (2007) Framework for Adapting to Climate Change in the Context of Urban Drainage Challenges in Kabwe, Zambia**

Muller's (2007) article on adapting to climate change through water management emphasizes the need for urban resilience in the face of changing climatic conditions. His focus on integrating water management with urban planning offers valuable insights for addressing the challenges of urban drainage systems in Southern African cities, specifically Kabwe, Zambia. Below is an expanded analysis based on Muller's framework, contextualizing it for Kabwe.

#### **1. Urban Resilience through Integrated Water Management**

Muller (2007) argues that urban resilience can only be achieved through integrated water management that includes both water supply and stormwater drainage systems. In Kabwe, the integration of water management systems can help reduce the impact of urban flooding and improve the effectiveness of drainage systems. The existing challenges in Kabwe, such as lack of coordination between water supply management and stormwater infrastructure, can be addressed by:

- Developing a unified urban water management strategy that incorporates flood risk reduction, water storage, and drainage system improvements.

- Using green infrastructure solutions, such as permeable surfaces and urban wetlands, which have the dual benefit of managing stormwater and enhancing water quality.

Muller (2007) stresses that cross-sectoral integration is essential for long-term resilience. For Kabwe, this means ensuring that drainage management is tied to broader urban development and climate change adaptation policies.

## **2. Climate Change Impacts on Drainage Systems in Kabwe**

Muller (2007) highlights that climate change exacerbates water management challenges in urban areas. For Kabwe, the increasing intensity and frequency of rainfall due to climate variability pose a direct threat to drainage systems. Key consequences of climate-induced flooding include:

- Overwhelming drainage capacity, leading to frequent blockages and surface flooding.
- Increased risk of waterborne diseases such as cholera, due to poor drainage and sanitation infrastructure.

Muller advocates for climate-resilient water management practices, which could be applied to Kabwe by:

- Investing in climate-resilient infrastructure capable of handling higher volumes of stormwater.
- Adopting flood risk assessments and modeling tools to better predict future rainfall patterns and potential drainage system failures.

## **3. Adaptive Management for Sustainable Drainage Systems**

One of the central tenets of Muller's (2007) work is adaptive management—the ongoing adjustment of systems based on continuous monitoring and evaluation. For Kabwe, adaptive management strategies can be employed to:

- Regularly monitor the performance of urban drainage systems to ensure that they are functioning effectively and can handle changing rainfall patterns.
- Flexibly adjust drainage infrastructure plans in response to real-time data and evolving climate conditions.
- Incorporate climate projections into urban planning to account for future changes in rainfall intensity and seasonal shifts.

Kabwe's drainage systems could benefit from smart technologies such as GIS-based monitoring and early warning systems that provide real-time data on flooding risks, allowing authorities to adapt quickly to changing conditions.

#### **4. Importance of Ecosystem-Based Approaches to Drainage in Kabwe**

Muller (2007) highlights the importance of ecosystem-based approaches to enhance urban resilience. This includes integrating natural systems (such as wetlands and floodplains) with engineered infrastructure. In Kabwe, ecosystem-based approaches could include:

- Restoration of natural wetlands and the use of bio-swales (vegetated drainage channels) to enhance stormwater retention and filtration.
- Promoting urban greening initiatives, such as tree planting and vegetation along waterways, which help absorb rainfall, reduce runoff, and improve water quality.

By integrating such solutions, Kabwe can reduce the dependency on traditional, expensive grey infrastructure while enhancing urban resilience to flooding and water scarcity.

#### **5. Governance and Institutional Framework for Climate-Resilient Drainage**

Muller (2007) emphasizes the importance of strong governance in implementing effective water management strategies. In Kabwe, weak institutional capacity is a major barrier to effective drainage management. Muller's recommendations can be applied by:

- Building institutional capacity within the Kabwe Municipal Council and other local agencies, equipping them with the necessary technical skills, resources, and authority to manage drainage systems and climate risks effectively.
- Promoting inter-agency collaboration between urban planning, environmental agencies, and public health departments to address the multifaceted challenges of drainage and climate change adaptation.
- Engaging the local community in flood risk management through public education campaigns and community-driven solutions.

By establishing a more coordinated institutional framework, Kabwe can better tackle the interconnected challenges of urban drainage, climate change, and sustainable development.

## 6. Financial and Investment Strategies for Drainage Improvements

Muller (2007) discusses the financial challenges faced by cities in adapting to climate change, particularly in the context of water management. For Kabwe, the lack of adequate funding limits its ability to improve drainage systems. Muller's approach includes:

- Leveraging international climate adaptation funding from sources such as the Green Climate Fund or the Global Environment Facility to finance drainage improvements.
- Exploring innovative financing models, such as public-private partnerships (PPP) and local levies, to fund urban drainage projects and maintenance.

**Review of Myers' (2011) alternative urban theory, the challenges of urban drainage systems in Southern African cities—exemplified by Kabwe, Zambia—can be re-examined** through a more nuanced and context-specific lens. Myers (2011) critiques conventional, often Eurocentric, urban planning models that tend to overlook the unique socio-political and historical trajectories of African cities. His work advocates for embracing local realities and alternative planning paradigms that are better suited to the multifaceted challenges faced by these urban environments.

### 1. Reframing Drainage as a Reflection of Broader Urban Dynamics

Myers (2011) argues that infrastructural issues, such as inadequate drainage systems, are symptomatic of deeper urban challenges, including rapid, unplanned urbanization and socio-economic disparities. In Kabwe, the recurring flooding and drainage failures can be seen as manifestations of historical neglect, rapid informal settlement growth, and a lack of integrated urban planning. This perspective urges policymakers to address drainage issues within the larger framework of urban development and governance reforms.

### 2. Context-Specific Planning and Local Knowledge

Rather than applying one-size-fits-all solutions, Myers (2011) calls for planning approaches that incorporate local knowledge and the lived realities of urban residents. For Kabwe, this means developing drainage solutions that are tailored to the city's specific climatic conditions, topography, and social context. Engaging local communities and incorporating indigenous practices can lead to more resilient and sustainable drainage systems that better serve the city's unique needs.

### **3. Holistic and Inclusive Governance**

In his work, Myers (2011) stresses the importance of rethinking urban governance to include a wider array of stakeholders and to break away from rigid, top-down administrative structures. Kabwe's drainage challenges are not merely technical problems but are deeply intertwined with issues of governance, resource allocation, and public participation. A more inclusive governance model, as proposed by Myers, would encourage collaboration between municipal authorities, local communities, and private entities to ensure that drainage infrastructure is maintained and improved in a manner that is both sustainable and equitable.

### **4. Innovation and Adaptive Strategies**

Myers (2011) envisions African cities as dynamic entities that are capable of innovative adaptations when traditional systems fail. Applying this to Kabwe suggests that innovative, adaptive strategies—such as the incorporation of nature-based solutions, community-driven maintenance initiatives, and flexible urban planning frameworks—could be critical in overcoming the entrenched challenges of outdated or insufficient drainage infrastructure.

## **Review of Pieterse's (2008) Analysis of Urban Development Crises and Its Implications for Drainage Challenges in Kabwe, Zambia**

In "City Futures: Confronting the Crisis of Urban Development" (Pieterse, 2008), the author explores the profound and multifaceted crises facing urban development in Southern Africa, particularly focusing on rapid urbanization, inadequate infrastructure, and the increasing vulnerability of cities to environmental stressors. Pieterse's analysis offers several insights that are directly applicable to the challenges of urban drainage systems in Kabwe, Zambia.

### **1. Urbanization and Informal Settlements: The Pressure on Drainage Systems**

Pieterse (2008) highlights the exponential growth of informal settlements as a key challenge facing many Southern African cities. In Kabwe, informal settlements, such as those found in Makululu, often lack basic services, including efficient drainage systems. Pieterse's argument that urbanization outpaces infrastructure development is particularly relevant here. In Kabwe, the combination of rapidly expanding urban populations and the proliferation of informal housing places enormous pressure on the city's already deficient drainage infrastructure, resulting in:

- Clogged drainage systems due to unregulated building practices and improper waste disposal
- Increased flood risks from the encroachment of settlements into flood-prone areas
- Deteriorating environmental conditions, exacerbated by the lack of planning for drainage in informal settlements

Pieterse's work calls for a comprehensive urban planning approach that addresses the integration of drainage systems into informal settlement areas through participatory planning and the formalization of these areas.

## **2. The Crisis of Infrastructure and Technological Deficiencies**

Pieterse (2008) critiques the insufficient infrastructure development in Southern African cities, noting that cities often face a crisis in infrastructure provision due to a combination of underinvestment, poor maintenance, and outdated technologies. Kabwe's drainage systems are emblematic of this crisis, where the existing infrastructure is outdated and poorly maintained, leading to the following challenges:

- Inadequate drainage capacity to cope with increasing rainfall and flooding events
- Lack of modern technologies for mapping and monitoring urban drainage, such as Geographical Information Systems (GIS) and flood forecasting models
- Failure to integrate drainage systems into broader urban planning frameworks, resulting in fragmented and inefficient infrastructure

Pieterse (2008) emphasizes the need for technological innovation and investment in infrastructure to cope with urban growth. For Kabwe, adopting smart city technologies for flood management and improving the resilience of drainage infrastructure would be key steps in addressing these issues.

## **3. Environmental and Climate Change Impacts on Urban Drainage**

The book also delves into the role of climate change in exacerbating urban infrastructure challenges, particularly in the context of increased flooding and changing rainfall patterns. Kabwe, like many Southern African cities, is experiencing the effects of climate change, leading to:

- More frequent and intense rainfall events that overwhelm existing drainage systems
- Soil erosion and land degradation, which further complicate drainage efficiency

- Increased pressure on urban settlements, particularly informal areas, to adapt to these environmental changes

Pieterse (2008) calls for climate-resilient urban planning that integrates adaptive solutions for managing the impacts of extreme weather events. For Kabwe, this could mean:

- Implementing sustainable drainage solutions, such as rainwater harvesting and green infrastructure, to mitigate the impacts of intense rainfall
- Developing climate change adaptation strategies within local urban planning and drainage policies

#### **4. Governance, Institutional Capacity, and Policy Gaps**

A major theme in Pieterse's (2008) work is the lack of effective governance in urban planning, often exacerbated by institutional fragmentation and policy incoherence. Kabwe's drainage system challenges reflect the gap between existing governance frameworks and the growing urban demands. Pieterse argues that cities need effective, inclusive governance structures to address urban crises like drainage. In the case of Kabwe, this manifests as:

- Poor coordination between municipal authorities, local government, and national agencies in urban drainage planning
- Lack of a comprehensive drainage policy that integrates with broader urban management frameworks
- Weak institutional capacity at local levels to manage drainage infrastructure, enforce regulations, and ensure compliance

According to Pieterse (2008), enhancing institutional capacity and policy coherence is essential for effectively addressing urban challenges. In Kabwe, this could involve:

- Establishing a centralized agency responsible for overseeing urban drainage projects and coordinating efforts between local and national government bodies
- Developing integrated drainage management plans that align with broader urban sustainability goals



## 5. Addressing the Equity and Inclusivity of Drainage Solutions

Pieterse (2008) stresses that urban solutions must prioritize equity and inclusivity to ensure that marginalized communities are not disproportionately impacted by urban crises. In Kabwe, informal settlements are particularly vulnerable to flooding and poor drainage, often due to their exclusion from formal urban planning processes. Pieterse advocates for inclusive governance that incorporates marginalized groups in decision-making processes. For Kabwe, this would involve:

- Community-based approaches to urban drainage, where local residents are involved in identifying drainage issues and implementing solutions
- Policy frameworks that prioritize marginalized areas in terms of drainage improvements and urban planning interventions

Conclusion: Reframing Urban Drainage Challenges in Kabwe Based on Pieterse's Insights

Pieterse's (2008) analysis provides valuable guidance for addressing the urban drainage challenges in Kabwe. By focusing on the following key areas:

1. Addressing urbanization and informal settlements through integrated planning and infrastructure provision
2. Investing in infrastructure and technology to improve drainage system efficiency and resilience
3. Building climate-resilient urban systems that can adapt to changing rainfall patterns and flooding
4. Strengthening governance and institutional capacity to ensure coordinated, effective urban planning
5. Promoting inclusive governance that incorporates the needs of marginalized communities

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3. Building climate-resilient urban systems that can adapt to changing rainfall patterns and flooding
4. Strengthening governance and institutional capacity to ensure coordinated, effective urban planning

5. Promoting inclusive governance that incorporates the needs of marginalized communities

## **Review of Pieterse & Parnell's (2014) Insights in the Context of Urban Drainage Challenges in Kabwe, Zambia**

Pieterse and Parnell's (2014) *Africa's Urban Revolution* offers valuable perspectives on urbanization dynamics, governance, and the transformation of urban spaces in Africa. Their analysis emphasizes that the rapid urbanization across the continent brings both opportunities and challenges, particularly in terms of infrastructure development and urban governance. These insights are crucial for understanding the urban drainage issues in Kabwe, Zambia, and provide a framework for addressing the growing challenges associated with urbanization and drainage systems.

### **1. Rapid Urbanization and Informal Settlements: A Key Driver of Drainage Issues in Kabwe**

One of the central themes in *Africa's Urban Revolution* is the accelerated rate of urbanization, particularly in sub-Saharan Africa, which presents significant challenges for cities like Kabwe. Pieterse and Parnell (2014) highlight how the growth of informal settlements often leads to unplanned urban sprawl, creating significant strain on drainage systems. In Kabwe, this trend manifests in:

- Inadequate drainage infrastructure in informal settlements, where drainage systems are either absent or poorly maintained. (See Appendix 5)
- Increased stormwater runoff in areas with high-density, unplanned housing, exacerbating flooding risks and overwhelming existing drainage capacities.
- Poor urban planning and zoning regulations, leading to settlements being built in flood-prone areas, making the drainage issue even more critical.

To address this, Pieterse and Parnell's framework suggests a need for inclusive urban planning that incorporates informal settlements into the city's overall urban development strategy. In Kabwe, this could involve integrating drainage systems into urban growth plans, ensuring that new developments are better equipped to handle stormwater management.

### **2. Urban Governance and Institutional Capacity in Managing Urban Drainage**

Pieterse and Parnell (2014) stress that effective urban governance is key to tackling urban challenges. They argue that local governments must play a central role in managing rapid

urbanization and the resulting infrastructure needs. In the case of Kabwe, weak institutional capacity contributes to:

- Inconsistent enforcement of drainage-related policies and regulations.
- Lack of technical expertise in designing and implementing sustainable drainage systems.
- Fragmented governance where various agencies and stakeholders work in isolation rather than collaboratively.

Drawing from Pieterse and Parnell's work, it is clear that strengthening local governance is essential for improving urban drainage systems in Kabwe. This could involve:

- Building institutional capacity through training and knowledge-sharing programs.
- Improving coordination between the municipal council, environmental agencies, and local communities to develop integrated drainage solutions.
- Ensuring that urban drainage planning is part of broader climate change adaptation strategies to better manage extreme weather events, such as floods.

### **3. Policy Integration and Strategic Urban Planning**

Pieterse and Parnell (2014) emphasize the importance of integrating urban development policies across various sectors. Urban drainage issues in Kabwe are exacerbated by a lack of integrated policy approaches, where land use, drainage, and urban development are treated as separate, isolated issues. In Kabwe, this results in:

- Lack of a cohesive strategy for urban drainage that integrates environmental, urban planning, and infrastructure needs.
- Policy incoherence between drainage management and other urban policies such as land-use planning, housing, and environmental protection.

To overcome these challenges, Kabwe must adopt holistic urban planning that integrates drainage systems with urban development and environmental policies. Pieterse and Parnell's argument for multi-dimensional policy integration suggests that drainage solutions should be embedded within broader urban resilience and sustainable development frameworks. This could involve:

- Designing stormwater management plans that complement land-use zoning, ensuring that drainage infrastructure is part of the city's sustainable growth.

- Incorporating green infrastructure such as permeable surfaces and vegetation into drainage systems to enhance their effectiveness.

#### **4. Climate Change and the Need for Resilience in Urban Drainage Systems**

Pieterse and Parnell (2014) highlight the intersection of climate change and urbanization, emphasizing the need for cities to become more resilient to climate-related shocks such as flooding, heatwaves, and droughts. In Kabwe, climate change impacts are becoming increasingly apparent, with more frequent and intense rainfall events contributing to:

- Flooding in low-lying areas due to the incapacity of the drainage systems to handle large volumes of water.
- Increased erosion in poorly managed drainage areas, further degrading the drainage infrastructure.

Drawing on Pieterse and Parnell's ideas, Kabwe must adopt climate-resilient drainage systems that can withstand the increased frequency of extreme weather events. This can be achieved through:

- Implementing flood prevention measures, such as the construction of retention ponds and flood barriers.
- Adopting climate-smart drainage technologies, such as water harvesting systems and permeable pavements, which can reduce the pressure on conventional drainage systems.

#### **5. Social Inclusion and Community Participation in Drainage Planning**

In *Africa's Urban Revolution*, Pieterse and Parnell (2014) stress the importance of social inclusion in urban planning, particularly for marginalized communities. In Kabwe, many informal settlements lack adequate drainage due to limited participation from local communities in urban planning processes. This results in:

- Exclusion of vulnerable populations from decision-making processes related to urban drainage infrastructure.
- Inequitable access to drainage solutions in informal settlements, where drainage problems are often neglected.

To address these issues, it is essential to integrate community participation into drainage planning. This can be achieved by:

- Encouraging local communities to engage in the planning and maintenance of drainage systems, ensuring that solutions are appropriate to their needs.
- Building public awareness around the importance of proper waste disposal and maintaining drainage channels to prevent blockages and flooding.

Pieterse and Parnell's (2014) analysis of Africa's urban revolution provides valuable insights into the challenges faced by Kabwe, Zambia, in managing urban drainage systems amidst rapid urbanization and climate change. Key takeaways for addressing drainage issues in Kabwe include:

Inclusive and integrated urban planning that combines land use, drainage, and environmental considerations.

Strengthening institutional capacity through improved governance and inter-agency coordination.

Community-driven approaches to urban drainage management that engage local residents in decision-making and maintenance.

Building climate resilience by adopting sustainable, climate-smart drainage solutions.

The publication by UN-Habitat on *Urban Governance* highlights key principles and frameworks that are crucial for improving urban management and addressing various challenges, including those related to urban drainage systems. Here are some further insights based on the relevance of urban governance to the topic of drainage systems in Southern African cities, specifically Kabwe, Zambia:

## 1. Importance of Institutional Capacity and Coordination

Urban governance emphasizes the need for strong institutional frameworks and the capacity of local authorities to manage urban challenges effectively. In the case of Kabwe, the ability of the local municipality to manage drainage systems hinges on its capacity to coordinate between various governmental and non-governmental actors, allocate resources efficiently, and implement policies that promote sustainable urban development. The lack of coordination among different stakeholders often exacerbates urban drainage issues, leading to flooding and poor stormwater management.



## 2. Decentralization and Community Participation

A central tenet of effective urban governance is the decentralization of authority to local governments and the active involvement of local communities. For Kabwe, empowering local authorities with the autonomy to make decisions about urban planning, drainage infrastructure, and maintenance can help create more tailored solutions to specific drainage challenges. Community participation is also critical in ensuring that drainage systems are maintained and that residents are engaged in managing waste and stormwater runoff, which directly impacts the functionality of drainage systems.

## 3. Policy Integration and Sustainability

UN-Habitat stresses the importance of integrating environmental considerations into urban governance policies. This includes incorporating sustainable practices into urban drainage systems. For Kabwe, where urbanization and informal settlements are growing, adopting sustainable drainage solutions that focus on nature-based solutions (e.g., permeable surfaces, green roofs, or wetlands) could help address the challenges posed by insufficient infrastructure. Policy integration also means that drainage issues should be aligned with broader goals such as climate resilience, poverty alleviation, and sustainable urban development.

## 4. Financial Resources and Investment

Urban governance frameworks often highlight the financial challenges that cities face in upgrading infrastructure. Kabwe's drainage systems suffer from inadequate funding, which hampers efforts to improve stormwater management. UN-Habitat suggests exploring innovative financing mechanisms, such as public-private partnerships, international funding, and local resource mobilization, to support infrastructure development and maintenance. Sustainable drainage solutions could be financed through these mechanisms, addressing both short-term and long-term challenges.

## 5. Adaptive Capacity to Climate Change

UN-Habitat's framework emphasizes the importance of enhancing a city's resilience to climate change. In Southern Africa, including Kabwe, the frequency of extreme weather events such as heavy rainfall and floods has increased, leading to the overburdening of drainage systems. Strengthening the adaptive capacity of urban governance through policies that promote climate-resilient infrastructure (e.g., improved drainage networks, flood control measures) can mitigate the adverse effects of climate change on urban drainage.

## 6. Data Systems and Technical Tools

Urban governance relies heavily on data systems to inform decision-making processes. For Kabwe, adopting robust data systems and technical tools, such as Geographic Information Systems (GIS) for mapping drainage infrastructure, can help identify problem areas, optimize maintenance, and improve long-term planning. Effective data-driven governance enables local authorities to monitor drainage systems and take proactive measures before problems escalate into disasters.

### **Review of Water Research Commission. (2011). *Report and South African Case Studies***

The 2011 Water Research Commission (WRC) report, focusing on South African case studies, provides valuable insights into the design, implementation, and evaluation of urban drainage solutions. While its primary context is South Africa, many of the identified themes and recommendations are transferable to other Southern African settings, including Kabwe, Zambia. Below are some key points and their relevance to the challenges of urban drainage systems in Kabwe:

#### **Holistic Drainage Approaches**

The WRC emphasizes *integrated stormwater management* and *water-sensitive urban design (WSUD)* as more sustainable alternatives to conventional drainage. In Kabwe, this could translate to the adoption of green infrastructure (e.g., constructed wetlands, bio-swales) that can improve water infiltration and reduce flooding risks.

#### **Institutional Coordination and Capacity**

The recurring theme in the WRC report is the importance of strong governance frameworks and institutional cooperation across municipal departments and stakeholder groups. For Kabwe, strengthening institutional capacity—through training, clear policy guidelines, and interdepartmental collaboration—can address fragmented responsibilities and improve overall drainage management.

#### **Community Engagement and Awareness**

The WRC highlights the role of *community-based initiatives* and public awareness in sustaining drainage projects. Similarly, Kabwe could benefit from participatory programs that encourage residents to maintain drains, avoid illegal dumping, and support local flood prevention measures.

## **Data-Driven Planning and Monitoring**

South African case studies within the WRC report underscore the necessity of robust data systems for flood modeling, infrastructure planning, and long-term monitoring. For Kabwe, investing in data collection (e.g., rainfall patterns, topography, land use) and digital mapping tools can lead to more targeted interventions and better emergency preparedness.

## **Financial Mechanisms and Resource Allocation**

The WRC identifies funding constraints as a major barrier to implementing innovative drainage solutions. In Kabwe, exploring diverse funding streams—such as public-private partnerships, donor agencies, and local taxes—could be crucial for scaling up and maintaining drainage infrastructure.

## **Adapting to Climate Variability**

Many South African municipalities face climate change-related challenges such as heavier rainfall events and prolonged droughts. The report suggests adaptive management strategies, including designing drainage systems that can cope with extreme weather variability. Kabwe similarly experiences erratic rainfall patterns, making climate-resilient infrastructure an urgent priority.

## **Replication and Contextual Adaptation**

While the case studies in the WRC report are rooted in South African contexts, they demonstrate how innovations and lessons can be transferred to other municipalities with similar environmental, socioeconomic, and institutional conditions. Kabwe can selectively adopt best practices—like integrating green corridors or enforcing stronger land-use regulations—while tailoring them to local realities.

## **Analysis**

Urban drainage systems in many Southern African cities, including Kabwe, Zambia, have struggled to keep up with the demands of rapid urbanization. The rising population, particularly in informal settlements, has put significant pressure on existing infrastructure. Kabwe, like many other urban centers, faces recurring flooding and waterlogging, which are further compounded by blocked drainage systems, inadequate maintenance, and insufficient investment in drainage infrastructure. These issues highlight the critical

importance of addressing urban drainage challenges for sustainable urban development and community well-being.

**Unplanned Settlements:** One of the major factors contributing to drainage inefficiency in Kabwe is the rapid growth of unplanned settlements, often located in low-lying areas. These settlements, built without proper consideration for drainage and flood risk management, exacerbate existing drainage issues. The expansion of informal settlements in flood-prone zones impedes the natural flow of water, leading to flooding, especially during heavy rains.

**Blocked Waterways:** The blockage of drainage channels, either due to waste disposal, vegetation overgrowth, or inadequate maintenance, is another significant challenge in Kabwe. These blockages prevent the efficient movement of stormwater, causing local flooding and waterlogging. Furthermore, waste disposal practices, such as dumping garbage in open drains, contribute to the degradation of the drainage system and the surrounding environment.

**Limited Investment in Infrastructure:** Kabwe, like many cities in the region, faces budgetary constraints that limit the ability to invest in upgrading or expanding drainage infrastructure. This lack of investment has led to outdated and insufficient drainage systems that are unable to cope with the increasing volume of stormwater. The absence of modern and well-maintained drainage infrastructure further intensifies the risk of flooding.

### **Impact of Ineffective Drainage Systems**

**Public Health Risks:** The failure of urban drainage systems in Kabwe has direct and indirect effects on public health. Frequent flooding creates ideal conditions for the spread of waterborne diseases, such as cholera and dysentery, and provides breeding grounds for mosquitoes, which can lead to the spread of malaria. Poor drainage also contributes to poor sanitation, leading to further health risks.

**Environmental Degradation:** Flooding and waterlogging damage the urban environment by eroding soil, polluting water sources, and reducing green spaces. The inefficient drainage systems also exacerbate soil erosion, contributing to the loss of fertile land and threatening agricultural production in the region.

**Disruption of Livelihoods:** Frequent flooding disrupts economic activities, particularly for those in informal sectors. Businesses and homes in flood-prone areas face substantial damage to property, while transport networks are often rendered impassable. These disruptions hinder local economic development and affect residents' quality of life.

## Findings

**Integrated Urban Planning:** An essential recommendation to address drainage challenges in Kabwe is the integration of drainage planning into urban development policies. This includes zoning regulations that prevent construction in flood-prone areas, the development of drainage infrastructure alongside housing projects, and consideration of natural water flow patterns during urban planning.

**Improved Drainage Maintenance:** Regular and proactive maintenance of existing drainage systems is critical to ensuring their continued efficiency. The research suggests that local authorities should prioritize clearing blocked waterways and ensuring that the drainage infrastructure is kept in good working condition. Public education on proper waste disposal practices can also contribute to preventing blockages.

**Policy Interventions:** There is an urgent need for policy interventions to secure funding for drainage system improvements and flood mitigation measures. The government, in collaboration with development partners, should focus on creating a long-term strategy for addressing drainage issues, which includes investing in climate-resilient infrastructure and adopting modern stormwater management techniques.

**Community Engagement:** Engaging local communities in flood risk management and urban planning processes is vital. Public participation can help raise awareness of the importance of proper drainage maintenance and encourage behavior changes that reduce environmental pollution and waste. Involving residents in the decision-making process also fosters a sense of ownership and responsibility toward their environment.

## SUMMARY

Urban drainage challenges in Kabwe mirror broader issues faced by many Southern African cities (See appendices 1 and 4). To tackle these problems, an integrated approach is necessary, focusing on effective urban planning, improved drainage maintenance, infrastructure investment, and strong policy frameworks. By addressing these areas, Kabwe can reduce flooding, improve public health, and foster sustainable urban growth. This study offers insights that can be applied to other cities in the region, contributing to sustainable urbanization across Southern Africa. The 2011 Water Research Commission report highlights the importance of integrated approaches, coordination among institutions, and community engagement in managing urban drainage. Its case studies provide valuable lessons that can guide Kabwe in managing stormwater, reducing flood risks, and building resilient infrastructure. While Zambia's regulatory environment differs

from South Africa's, the principles of holistic planning and multi-stakeholder collaboration remain relevant for Kabwe.

The UN-Habitat publication on Urban Governance provides a framework for improving urban drainage systems in Southern African cities, including Kabwe. Strengthening institutional capacity, promoting decentralization, integrating policies with sustainability goals, and improving financial and technical resources are key strategies for addressing drainage challenges. These approaches will help create a more resilient, sustainable, and inclusive urban environment. Urban drainage challenges in Kabwe go beyond technical issues; they are rooted in the city's socio-economic and historical context. A holistic, locally grounded approach that treats drainage systems as integral components of an urban ecosystem can lead to more effective, sustainable solutions.

Muller's principles of integrated water management, adaptive strategies, ecosystem-based solutions, and strong governance offer a foundation for addressing Kabwe's drainage challenges. By adopting these principles, the city can build resilience to climate change and rapid urbanization.

Jaglin's insights emphasize the need for a governance model that considers urban heterogeneity while promoting inclusive drainage solutions. Similarly, the Habitat III Policy Unit 4 (2016) and the G20 framework provide valuable governance-oriented frameworks for improving urban drainage in cities like Kabwe through institutional reforms, technical capacity building, community engagement, and climate adaptation.

Clark's framework of uneven innovation is particularly relevant for Kabwe, highlighting the need for data-driven urban planning, interdepartmental coordination, and equitable resource allocation. Finally, applying principles from Carden et al. (2013) and Armitage et al. (2013) on integrated water-sensitive urban planning and climate-adaptive drainage solutions can enhance resilience, reduce flood risks, and promote sustainable water management in Kabwe and other Southern African cities.

## RECOMMENDATIONS

### Integrated Urban Planning

Governments and urban planners should adopt an integrated approach to urban development that incorporates effective drainage management into the planning process. This should include zoning regulations that limit settlement in flood-prone areas and the development of sustainable, climate-resilient urban infrastructures.

### **Improved Drainage Infrastructure**

There is an urgent need to invest in modern drainage infrastructure. This involves expanding and upgrading existing drainage systems to accommodate increased water runoff, especially in rapidly urbanizing areas. Stormwater management should be prioritized to reduce flooding and waterlogging in urban areas.

### **Regular Maintenance and Cleaning of Drainage Systems**

Implement regular cleaning and maintenance programs for drainage systems to ensure they remain free of blockages caused by waste, debris, and overgrown vegetation. This will enhance their efficiency and reduce the risk of flooding during heavy rains.

### **Community Awareness and Engagement**

Educating communities about the importance of maintaining clean drainage systems and avoiding improper waste disposal is essential. This will foster a sense of ownership and responsibility towards the drainage systems, reducing blockages caused by littering and unauthorized waste dumping.

### **Policy and Regulatory Reforms**

The Zambian government should establish and enforce policies that promote sustainable urban drainage management. This includes improving enforcement of regulations related to land use, waste management, and flood control. Additionally, collaboration between local authorities, urban planners, and environmental experts is vital to ensure effective policy implementation.

### **Investment in Climate-Resilient Infrastructure**

With increasing climate variability, it is crucial to develop climate-resilient infrastructure. Investment should be directed toward building flood-resistant drainage systems, rainwater harvesting systems, and sustainable urban water management technologies to reduce the impacts of climate-induced flooding.

### **Stakeholder Collaboration and Partnerships**

Encourage multi-stakeholder collaboration between government agencies, local communities, NGOs, and private sector actors. This could include joint efforts for funding, implementing solutions, and monitoring progress, ensuring a holistic approach to improving urban drainage systems.

### **Adoption of Nature-Based Solutions**

Promote the use of nature-based solutions, such as green infrastructure, permeable surfaces, and wetland restoration, to enhance the city's natural drainage capacity and mitigate the negative impacts of urbanization on the drainage systems.



## APPENDICES

### APPENDIX 1



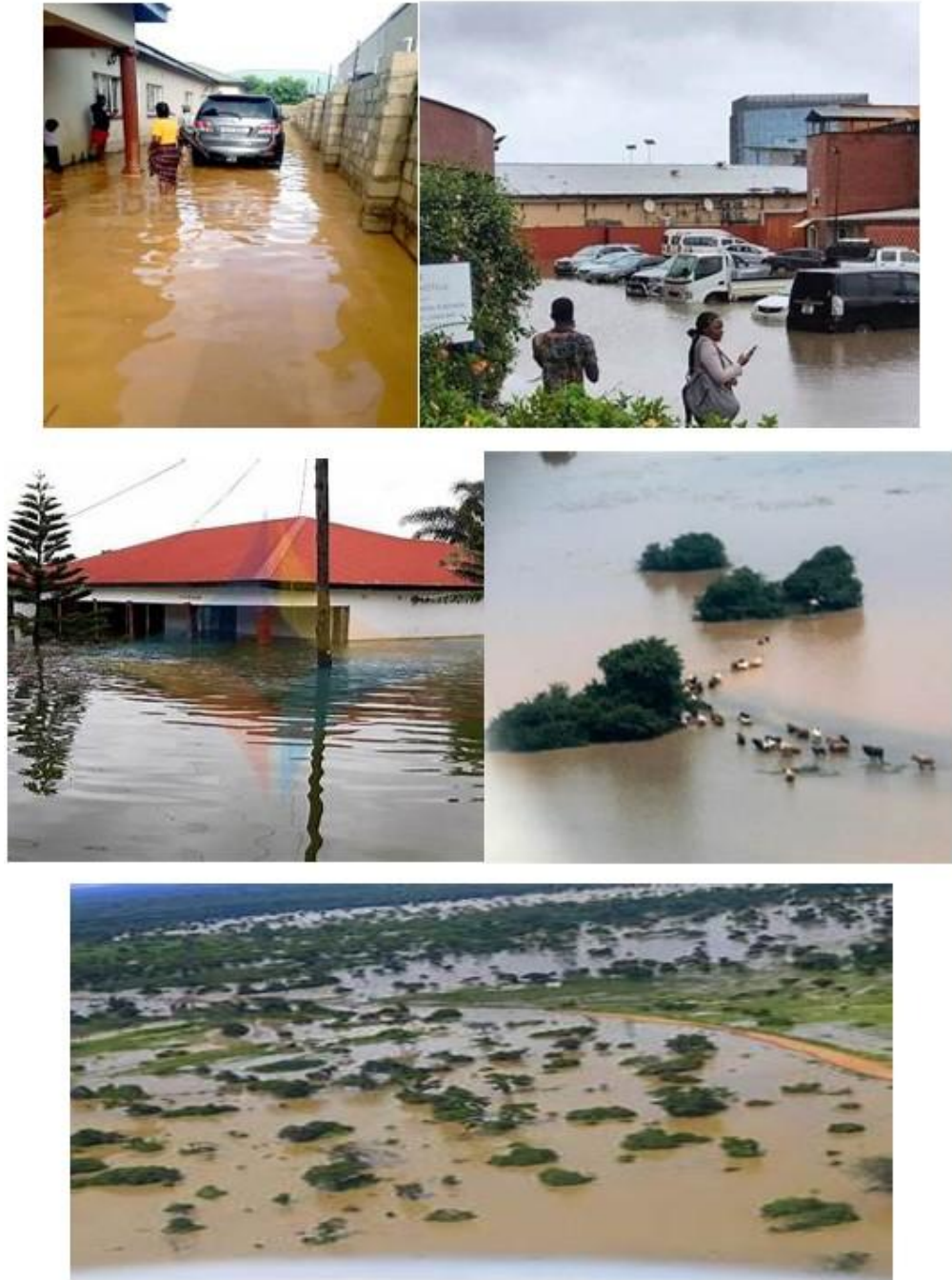
**Appendix 1: Shows floods in Botswana in different places in February 2025**

**APPENDIX 2**



**Appendix 2: Shows unblocking drainage system in different parts of Kabwe District**

**APPENDIX 3**



**APPENDIX 3 SHOWS Floods in different parts of Zambia in February 2025**

**APPENDIX 4**



**APPENDIX 4: SHOWS Floods in different parts of South Africa in Jan/Feb 2025**

**APPENDIX 5**



**APPENDIX 5: SHOWS Floods in different parts of Makululu and Mine area in Kabwe - Zambia Feb 2025.**

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## About the Author



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